PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/SE2002/002451	International filing date *(day/month/year)* 23-12-2002	Priority date *(day/month/year)* -
International Patent Classification (IPC) or national classification and IPC H01P 7/10		
Applicant Telefonaktiebolaget LM Ericsson (publ) et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 3 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))
      _____, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - ☒ Box No. I Basis of the report
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☐ Box No. VIII Certain observations on the international application

Date of submission of the demand	Date of completion of this report
07-06-2004	22-03-2005
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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/SE2002/002451

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of:

☐ international search (under Rules 12.3 and 23.1(b))
☐ publication of the international application (under Rule 12.4)
☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

☐ the international application as originally filed/furnished

☒ the description:

pages 1-19 as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____

☒ the claims:

pages _____ as originally filed/furnished
pages* _____ as amended (together with any statement) under Article 19
pages* 20-22 received by this Authority on 19.01.2005
pages* _____ received by this Authority on _____

☒ the drawings:

pages 1/12-12/12 as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, sheets/figs _____
☐ the sequence listing *(specify)*: _____
☐ any table(s) related to the sequence listing *(specify)*: _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, sheets/figs _____
☐ the sequence listing *(specify)*: _____
☐ any table(s) related to the sequence listing *(specify)*: _____

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/SE2002/002451

Box No. V **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-15	YES
	Claims		NO
Inventive step (IS)	Claims	1-15	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

Documents cited in the International Search Report:

D1: Derwent's abstract, No 94-158338/19, Abstract of SU 1800523
D2: WO 96 11 510 A1
D3: WO 99 10 948 A1
D4: WO 99 66 585 A2
D5: IEEE Trans. on Microwave Theory and Techniques, Vol. 3, Issue Dec. 2000, p. 1441-1444
D6: Patent Abstract of Japan, abstract of JP 2000-101314 A

Document D1 is considered to represent the closest prior-art. In the document, a microwave dielectric resonator including a tuning arrangement is shown. The tuning arrangement comprises a cylindrical tuning element consisting of a metal rod part and two cylindrical dielectric parts having different dielectric permittivity. An annular resonator attached to a substrate is arranged coaxially to the tuning element. By moving the tuning element into and/or out of the annular dielectric resonator, the frequency may be adjusted with improved linearity.

The cited documents D2-D6 represent the general state of the art.

The invention as described in the amended claim 1 differs from the closest prior-art by subdividing the tuner into an arbitrary number of sections, each of which is distinguishable by their geometrical shape.

The claimed invention according to the amended claim 1 therefore has novelty.

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: Box V

The problem to be solved by the present invention may therefore be regarded as eliminating the non-linear relation between tuner position and resonator frequency.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

By subdividing the tuner into sections having predetermined geometrical shapes, thereby achieving a known, non-uniform distribution of the effective dielectric permittivity of the tuner, non-linear changes of the resonator frequency may be equalised and tuning precision increased.

The prior-art document D1 does not suggest a solution in which the geometrical shape of the tuner is varied along its length.

Claims 2-10 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

The invention as claimed in claims 11-15 relates to a tuning arrangement wherein the resonator is provided with a non-uniform distribution of the effective permittivity along the axis of tuner displacement, to attain the same result as with the invention according to claim 1.

None of the cited documents show or suggest a solution as described in claims 11-15.

Therefore, the invention defined in claims 1-15 is not disclosed by any of the cited documents.

The cited prior art does not give any indication that would lead a person skilled in the art to the claimed tuning arrangement. Therefore, the claimed invention is not obvious to a person skilled in the art.
Accordingly, the invention defined in claims 1-15 is novel and is considered to involve an inventive step. The invention is industrially applicable.

CLAIMS

1. A tuning arrangement for equalising non-linear frequency changes within a certain frequency range in response to tuner displacements relative to a resonator body,

c h a r a c t e r i s e d i n

the tuner (30) comprising a non-uniform distribution of the effective dielectric permittivity along the axis of tuner displacement whereby said non-uniform distribution of the effective dielectric permittivity is realised by subdividing the tuner (30) into an arbitrary number of sections (311,312,313,314), each of which distinguishable by their geometrical shape.

2. The tuning arrangement according to claim 1, whereby said tuner is subdivided into sections that can be distinguished by the value and distribution of the dielectric coefficient ε_r.

3. The tuning arrangement according to claim 1 or 2, whereby the effective tuning area is within a hollowness of the resonator.

4. The tuning arrangement according to claim 1 or 2, whereby the effective tuning area is outside of the resonator.

5. The tuning arrangement according to claim 3, whereby the tuner (41) includes two cylindrical sections (411,412a) comprising a ratio d_1/d_2 of section diameters within a range from 1.1 to 1.6 and a corresponding ratio l_1/l_2 of section lengths within a range from 0.2 to 0,4.

6. The tuning arrangement according to claim 3, whereby the tuner (51) includes two sections (511,512) having a constant diameter comprising a ratio $\varepsilon_{r1}/\varepsilon_{r2}$ for the values of the

dielectric coefficients of the sections within a range from 2.5 to 3.5 and a corresponding ratio l_1/l_2 for the section lengths within a range from 0.2 to 0.4.

7. The tuning arrangement according to claim 4, whereby the tuner (81) includes two sections (811a,812a) comprising a ratio d_1/d_2 for the section diameters within a range from 1.1 to 2 and a corresponding ratio l_1/l_2 for the section lengths within a range from 1.2 to 2.8.

8. The tuning arrangement according to claim 4, whereby the tuner (81) includes two sections (811b,812b) having a constant diameter comprising a ratio $\varepsilon_{r1}/\varepsilon_{r2}$ for the values of the dielectric coefficients of the sections within a range from 1.2 to 4 and a corresponding ratio l_1/l_2 for the section lengths within a range from 1.2 to 2.8.

9. The tuning arrangement according to one of claims 1-8, whereby the tuner (41,51,71,81) is equipped with a hollowness for fastening of an axis.

10. The tuning arrangement according to claim 9, whereby the axis of tuner displacement is arranged centrally through the resonator hollowness.

11. A tuning arrangement for equalising non-linear frequency changes within a certain frequency range in response to tuner displacements relative to a resonator body,

c h a r a c t e r i s e d i n

the resonator (34) comprising a non-uniform distribution of the effective dielectric permittivity along the axis of tuner displacement.

12. The tuning arrangement according to claim 11, whereby the non-uniform distribution of the effective dielectric permittivity is realised by subdividing the resonator into an arbitrary number of sections (341,342,343,344), each of

which distinguishable at least by their geometrical shape and the value and distribution of the dielectric coefficient ε_r.

13. The tuning arrangement according to claim 11 or 12, whereby the resonator consists of two sections (721a,722a) having a constant dielectric coefficient comprising a ratio d_1/d_2 of the diameters of the hollowness in each section within a range from 1.1 to 2.0 and a corresponding ratio l_1/l_2 of the section lengths within a range from 1.5 to 4.5.

14. The tuning arrangement according to claim 11 or 12, whereby the resonator consists of two sections (721b,722b) having a constant diameter, a ratio $\varepsilon_{r1}/\varepsilon_{r2}$ for the values of the dielectric coefficients of the sections within a range from 1.4 to 4 and a corresponding ratio l_1/l_2 for the section lengths within a range from 1.5 to 4.5.

15. The tuning arrangement according to one of claims 11-comprising a tuner according to one of claims 1-10.